

The Paradigm of Naval Mine Countermeasures: A Study in Stagnation

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EXECUTIVE SUMMARY

Title: The Paradigm of Naval Mine Countermeasures: A Study in Stagnation

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Thesis: Significant deficiencies in the development of naval mine countermeasures doctrine have hampered the effective employment of naval forces in both blue water and littoral operations for many years.

Discussion: The U.S. Navy has struggled with the difficult task of mine clearance operations for well over 100 years. These struggles have been marked by a propensity to react to current or past mine threats in developing force structure and employment methodologies. This reactionary approach to mine countermeasures is identified in three recurring themes; the lack of a published doctrine, the failure to fully integrate mine countermeasures forces into the operating forces, and the fragmentary development of technology without the focusing element of a coherent doctrine to guide research and development efforts. These themes are recognizable in the changing mine countermeasures force structure that has resulted from the Navy's reaction to mine threats manifested in various conflicts. Naval mine countermeasures and procedures have been historically reactionary and essentially unfocused in their evolution. Examples of these difficulties can be identified in Wonson Harbor during the Korean War, the Vietnam War, the Gulf War, and in present day planning for expeditionary warfare employment.

Contemporary mine countermeasures forces reflect the reactionary developmental process followed in the past. The paradigm that is reflected in the recurring themes discussed in the foregoing continues to paralyze mine countermeasures development. The Navy has published a number of documents that purport to move the mine countermeasures forces into a more effective and efficient force posture. The problems with these documents are that they universally fail to include the U.S. Marine Corps as a full participant, and seek to solve conceptual problems with technological solutions.

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Conclusion(s) or Recommendations(s): There are four recommendations to be made. First, a comprehensive, coherent, naval mine countermeasures doctrine should be developed by the Naval Doctrine Command. Secondly, a reorganization of the Mine Warfare Command should be undertaken to fully integrate the Marine Corps, by rotating leadership between a Navy Flag officer and a Marine Corps General officer. Thirdly, the operational command and control hierarchy for amphibious operations should be adjusted so that the Mine Warfare Commander reports to and works for the Landing Force Commander. Within this recommendation is the suggestion that the relationship between Commander, Amphibious Task Force (CATF) and Commander, Landing Force (CLF) be changed to co-equal for planning *and execution*. Finally, the training cycles for all MCM forces, both Navy and Marine Corps, should be aligned with the inter-deployment cycles of the forces which they will support.

Preface

This paper discusses the past, present, and future conceptual foundations of naval mine countermeasures and the development of operational concepts and procedures. It is my intent to illustrate recurring themes in force development and seek to determine the possible causes of these themes. **The central focus of this paper is to discuss how the lack of a coherent doctrine has had a detrimental effect on the evolution of mine countermeasures forces.** The issue of mine countermeasures is particularly relevant as the services seek to assume an expeditionary warfare posture. The requirement for effective mine countermeasures as an enabling activity is crucial for the continued success of amphibious operations. This paper looks briefly at historical precedents that have formed the paradigm of naval mine countermeasures. The focus, however, is mainly on the thought process and ideology that created and sustains the force structure for mine countermeasures.

This Master of Military Studies paper is not meant to be a historical recounting of operational failures. The brief discussion of force development is offered to build an understanding of rationales used for force development and operational employment. Additionally, little space is given in accounting for specific details of how many and what type of assets have been used in the past. Most of the sources consulted and used are contemporary concept publications and joint and service doctrinal works. There is one notable exception: the superb work by Dr. Tamara M. Melia, *“Damn The Torpedoes”*: *A Short History of U.S. Naval Mine Countermeasures, 1777-1991*.

The conclusions reached are that the lack of a coherent doctrine has, and continues to constrain, the evolution of naval mine countermeasures. Secondly, many of the published concept works fail to include the Marine Corps as a inseparable part of naval mine countermeasures operations. Finally, mine countermeasures as they are currently envisioned will not permit a seamless integration of forces for power projection ashore.

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THE PARADIGM OF NAVAL MINE COUNTERMEASURES: A STUDY IN STAGNATION

CHAPTER 1

NAVAL MINE COUNTERMEASURES DEVELOPMENT

Significant deficiencies in the development of naval mine countermeasures doctrine have hampered the effective employment of naval forces in both blue water and littoral operations for many years. The operational employment doctrine of naval mine countermeasures (MCM) forces has not evolved in a directed manner: rather it is based essentially on procedures developed in the early 1950's. The words "operational employment doctrine" are used here to facilitate the principle assertion of this master's paper that the U.S. Navy does not have, nor has it ever had, a comprehensive, coherent stand alone doctrine for naval mine countermeasures. Naval mine countermeasures operations are articulated principally in NWP-27 (series) *Mine Warfare*, which has recently been revised and renumbered as NWP 3-15, *Mine Warfare* to coincide with the numbering system for joint publications. These publications do provide some broad guidance, but are principally a compilation of the tactics, techniques and procedures employed in naval mine warfare. These publications are "how to" manuals instead of overarching doctrinal pieces. These significant deficiencies can lead but to one conclusion: there is no comprehensive, coherent stand alone doctrine for naval mine countermeasures.

Little progress has been made from a doctrinal standpoint in aligning force employment with evolving operational concepts. Naval mine countermeasures and procedures have historically been reactionary and essentially unfocused in their evolution. The U.S. Navy's historical approach to mine countermeasures has followed a flawed reasoning process summarized by Dr. Tamara M. Melia: "By its very nature MCM evolves as the result of new mine developments and changing threats."¹ The recurrent themes that form the basis for these problems are threefold: the lack of published doctrine, the failure to fully integrate mine countermeasures forces into the operating forces, and the fragmentary development of technology without the focusing element of a coherent doctrine to guide research and development efforts. The frequent failures of naval mine countermeasures operations lend credence to the premise put forward in NDP-1, *Naval Warfare*, that "The success of an organized military force is associated directly with the validity of its doctrine."²

COLD WAR DOCTRINE

Perhaps the most illustrative historical period in which to examine examples of the themes that sustain the stagnation of naval mine countermeasures operations is the period of the Cold War. The genesis of naval mine countermeasures for this period

¹ Dr. Tamara M. Melia, "*Damn the Torpedoes*": *A short History of U.S. Naval Mine Countermeasures, 1777-1991* (Washington, D.C.: Naval Historical Center, 1991), 137

² Naval Doctrine Publication 1, *Naval Warfare* (Washington, D.C.: Department of the Navy, 28 March 1994), ii

can be traced to the reactionary initiatives undertaken to counter mine threats and losses suffered in Wonson harbor during the Korean War.

In October 1950 Vice Admiral Arthur D. Struble, commanding Task Force 95 comprised of 250 ships, was tasked with making an amphibious landing at Wonson. Opposing this landing was an extensive minefield of over 3,000 mines laid over a 400 square mile area in and around Wonson harbor. The majority of these mines were Russian pre-World War I moored contact mines, but interspersed between them were new magnetic influence mines. These new Soviet influence mines were sophisticated enough to be activated by the magnetic signature of wooden hulled mine sweeper engines. The mine sweepers USS Pirate (AM-275), USS Pledge (AM-277), and the ROKN mine sweeper YMS-516 were all sunk by these new Soviet mines.³

The mine clearance operations delayed the landing at Wonson for over a week. The mine threat that manifested itself in these waters, and the attendant losses to the Navy that the mine threat achieved, infused funding into a mine countermeasures construction and development program. This resulted in a flexible mix of vessels designed to meet the Soviet threat encountered in Wonson harbor. This building program eventually delivered 85 ocean mine sweepers (MSOs) of the Aggressive and Agile class for U.S. and allied use, and 159 coastal mine sweepers (MSCs) of the Bluebird and Adjutant class, all but 20 of these vessels destined for export. Additionally, this building program was responsible for the conversion of eight existing

³ Melia, *"Damn the Torpedoes"*, 70-79

amphibious ships to use for surface and air mine countermeasures support, as well as MCM command and control ships.⁴

Unfortunately, the building program was not based on a comprehensive doctrine that detailed how these vessels would be integrated into the operational fleets. This building program was essentially a *reactionary response* to address shortfalls illuminated in Wonson harbor, and not a sustained commitment to the development of mine countermeasures.⁵

One positive aspect of the Wonson operations was the successful integration of helicopters as mine spotters, working ahead of surface ships for safety and mine clearance operations. These successful coordinated operations engendered interest in development of a mine clearance system which could be towed from a helicopter, and used as a precursor sweep in front of surface MCM vessels. The first successful operational of helicopter sweep gear was achieved in early 1952, when a helicopter successfully towed sweep gear to clear moored contact mines. This research and development initiative continued on a small scale until the beginning of the Vietnam War, in which aviation mine countermeasures were eventually to play a major role in mine countermeasures.⁶

As the Navy had no published doctrine to sustain interest in mine countermeasures, and there were no further catastrophic events to focus MCM efforts in the late 1950's and 1960's, mine countermeasures receded from importance in the Navy. This stagnation of effort is a recognizable recurring cycle. As U.S. naval historian Dr.

⁴ Melia, "*Damn the Torpedoes*", 83-90

⁵ *ibid.*, 85-86

⁶ *ibid.*, 79-90

Melia remarked, "Although Wonson made the entire Navy more mine-conscious, competing concerns quickly returned MCM to its isolated position."⁷ The fragmentary development of technologies to meet the threats such as those in Wonson, without the focusing element of a coherent doctrine, virtually assured that the U.S. would again be unprepared to meet the next mine countermeasure challenge.

The experiences of the U.S. Navy during the Vietnam War both helped and hindered mine countermeasures efforts. Due to the nature of that conflict, mining and mine countermeasures were not common activities. The principle threat from mines were predominately shallow water and riverine mine types. These mines included a small number of Soviet influence mines, simple contact mines, drifting mines, rudimentary controlled mines, and limpet mines.⁸ As these types of mines were not a significant threat to larger ships, and classic amphibious operations were not routinely undertaken, Dr. Melia assessed that the "Navy came to view MCM as a small-scale specialty rather than a major element of naval warfare."⁹ This viewpoint exacerbated the Navy's tendency to isolate mine countermeasures forces from other operating forces.

The Navy's *reaction* to the threats imposed by shallow water and riverine mines was to seek alternative methods of clearance to replace surface MCM vessels. This provided some positive developments in countermeasures technology with increased interest in airborne mine countermeasures. Developments in aviation mine countermeasures capabilities in the interim between the first operational testing in early 1952 and 1970 convinced Admiral Elmo Zumwalt, Chief of Naval Operations, that

⁷ ibid., 90

⁸ ibid., 89-92

⁹ ibid., 91

aviation mine countermeasures (AMCM) forces could provide the Navy with a safe, inexpensive, and rapid reaction counter to Soviet mine threats. In 1970 Admiral Zumwalt embarked the Navy on a significant building program, with aviation mine countermeasures as the Navy's central focus. This building program was undertaken at the expense of the surface mine countermeasure forces, which had fallen to a low state of readiness and operational capability.¹⁰ Consistent with the Navy's historical approach to new mine threats, aviation mine countermeasures developed specifically to counter a current threat, bereft of a published doctrine to define the scope of AMCM within the larger context of naval operating forces.

During the period of the mid-to-late 1970's, as the Navy focused on development of aviation mine countermeasures capabilities, the Soviet Union continued development of a variety of new mines to use against the U.S. Navy. Through an aggressive research and development program, the Soviet Union was able to develop a family of "smart" mines, and more importantly, a family of deep-moored rising mines.¹¹ These "smart" mines employed basic microprocessor technology in order to discriminate between real and false targets, making it possible to employ them against a specific ship type or class. Deep-moored rising mines, usually some type of torpedo or rocket, are laid in deep water and are activated by a variety of influence triggers which release the torpedo or rocket to actively or passively attack the target ship.

The capability of the Soviets to employ deep-water rising mines presented a major threat to the capital ships of the U.S. Navy and its allies, specifically the aircraft carriers.

¹⁰ *ibid.*, 94-113

¹¹ Definitions and discussion of various mine types are provided in ANNEX B, and in Naval Mine Warfare Engineering Activity, *Navsea Mine Familiarizer*, (Yorktown, VA: American Defense Preparedness Association, April 1985).

This mine type also posed, perhaps for the first time, a strategic threat as variants of the rising mines were built for antisubmarine employment and thus posed a credible threat to the SSBN fleet.¹² The Navy once again found itself *reacting* to a significant threat, armed indifferently with the types of mine countermeasures forces that resulted from a piecemeal development of technology without the focusing element of a coherent doctrine for guidance. To further add to the level of consternation attendant with the new Soviet mine technologies, several breakout exercises in 1979 and 1980 using experimental models of several Soviet mine types occurred. The result: As Cyrus Christensen concluded "all of the forces the U.S. Atlantic fleet could bring to bear could not open one East Coast port in any acceptable period of time."¹³

The threat of deep-water Soviet mines sparked a resurgence of interest in surface mine countermeasures vessels with a deep sweep capability.¹⁴ The long neglected and aging fleet of surface MCM vessels produced after the Wonson experience were insufficient to meet the new "blue water" threat: hence a new building program was undertaken to meet the new threat. Unfortunately, and as after the Korean War, this building program was not undertaken in consonance with a published doctrine for integration of the new ship types into the operating forces. Additionally, this lack of doctrine to guide research and development efforts produced a familiar approach, that of improving old equipment to do new tasks. This new building initiative, after several abandoned projects and concepts, eventually provided the Navy with ships of the MCM-1

¹² Melia, "*Damn the Torpedoes*", 114-115

¹³ Cyrus R. Christensen, "A Minesweeping Shrimp Boat? A what?" U.S. Naval Institute *Proceedings* 107 (Jul 1981): 109, as quoted in Melia, "*Damn the Torpedoes*", 116

¹⁴ *ibid.*, 115

Avenger class and MHC-51 Osprey class, built to provide the Navy with a blue water deep-sweep capability, and a coastal and harbor clearance capability.¹⁵ In any event, the build up and decline cycles, based on current or historical threats, illustrate the reality that "The central problem of MCM throughout history has been the difficulty of sustaining maximum capability over time."¹⁶

During the Cold War, the U.S. Navy viewed MCM forces as small scale specialty forces. Thus, conscious policy dictated reliance on NATO allies for MCM forces in the event of conflict with the Soviet Bloc.¹⁷ The failure to fully integrate mine countermeasures forces into the operating forces of the fleet was a deliberate convention. Hence, shortfalls in MCM assets were known and discounted as the Maritime Strategy,

. . implicitly admitted that the United States did not possess adequate forces to protect even our own harbors and coastal waters, let alone project mine countermeasures platforms into regions where the global battles would be fought.¹⁸

¹⁵ ibid., 112-140

¹⁶ ibid., 137

¹⁷ Office of the Chief of Naval Operations, *Mine Warfare Plan: Meeting the Challenges of an Uncertain World* (Washington, D.C.: Department of the Navy, 29 January 1992), 36

¹⁸ ibid., 36-37

GULF WAR OPERATIONS

Naval operations during Operations *Desert Shield* and *Desert Storm* in 1990 and 1991 did validate to some extent the Cold War maritime strategy of reliance on NATO allies for mine countermeasures forces. During the Gulf War period coalition mine countermeasures forces numbered 36 surface MCM (SMCM) ships, six airborne MCM (AMCM) helicopters, and two self-propelled acoustic-magnetic sweep (SAMS) systems from eight countries. These forces came from Belgium, France, Germany, Italy, Japan, the Netherlands, the United Kingdom, and the United States.¹⁹ The United States provided five surface MCM (SMCM) ships, six airborne MCM (AMCM) helicopters, two Self-propelled Acoustic-Magnetic Sweep (SAMS) systems, and several detachments of Explosive Ordnance Disposal (EOD) personnel. US MCM forces ranked fourth in the number of total mines cleared during the Gulf War period. This included the notable accomplishment of being the only units to successfully hunt and neutralize the advanced "Manta" bottom mine.²⁰

The success of coalition MCM forces could be argued as a "proof of concept" of the Cold War maritime strategy except for one major pointed result: the Iraqis were successful in shaping sea borne operations by their use of naval mines employed in consonance with well constructed beach defensive positions; This ultimately prevented an amphibious landing into Kuwait. Also, the majority of successful clearance operations were undertaken after the cessation of hostilities. Significantly, operational

¹⁹ *ibid.*, 15

²⁰ *ibid.*, 8

shortfalls during hostilities permitted the Iraqis to achieve shaping objectives in three distinct areas: preventing an amphibious assault, stalling the forward movement of a battle group (TF 151), and damaging two warships and permitting the successful targeting and engagement of a capital ship with anti-ship cruise missiles.²¹ The use of naval mines, in conjunction with elaborate beach defenses, thus allowed the Iraqis to manipulate the spatial and temporal aspects of the battlespace.

Iraqi shaping initiatives were facilitated by operational and institutional shortfalls within US Naval forces whose employment, as the Naval Doctrine Command concluded in *Mine Countermeasures: A Fighting Concept for the 21st Century*, reflected the reality that "Naval MCM has changed little from operations conducted during World War II and Korea to how we approached the mine threat during Desert Storm."²² These shortfalls were not limited to just the MCM assets themselves, but included command and control issues as well. The lack of a trained MCM staff in theater led to the establishment of the U.S. Mine Countermeasures Group (USMCMG): It served as the command and control staff for MCM operations in the Persian Gulf, but the staff was constituted and trained in theater. Thus, USMCMG required several months to stand up as an operational entity. Once fully constituted and trained, it embarked in USS TRIPOLI (LPH 10) in January 1991, and commenced operations to clear a 15 mile long, 1,000 yard track toward Kuwaiti beaches, as well as naval gunfire support areas.²³

²¹ ibid., 6-12

²² Naval Doctrine Command, *Mine Countermeasures: A Fighting Concept for the 21st Century*, unpublished draft produced by Naval Doctrine Command, 15 September 1996, 7

²³ Department of Defense, Office of the Chief of Naval Operations, *The United States Navy in "Desert Shield" "Desert Storm"*, (Washington, D.C.: Office of the CNO 15 May 1991), 41-44

The employment of US MCM forces in the Persian Gulf reflected the legacy of the recurring themes of failure, lack of doctrine, lack of integration, and technology developed to meet historical threats. The lack of good intelligence about the actual deployment of Iraqi mines complicated "a very real threat with psychological implications."²⁴ This particular issue goes to the heart of the real value of naval mines. Naval mines can achieve an objective without actually being laid, for the mere implication of the presence of mines is sufficient in many cases to act as a deterrent.

In naval operations it is just as critical to know where the mines are, as well as where they are not. Military planners in the Gulf War were presented with the difficult task of determining "where the mines were and how many of what types were actually in place."²⁵

What happens when such information is lacking? Two examples show the results. On 18 February 1991, while operating in the northern Persian Gulf in an area thought previously to have been cleared, USS Princeton (CG-59) struck an Italian Manta magnetic-acoustic influence mine. This mine type represents a state of the art "smart" bottom mine. The mine was laid in less than 60 feet of water and detonated at a lateral distance of 15 feet with 375 pounds of high explosive. On the same day, operating in the same area, USS Tripoli (LPH-10) struck a LUGM-145 mine. This moored, contact mine represents technology that was introduced prior to World War I and was indigenously produced in Iraq.²⁶ The two mine types employed illustrate the spectrum of the mine

²⁴ CNO, *Mine Warfare Plan: Meeting the Challenges of an Uncertain World*, 2

²⁵ *ibid.*, 2

²⁶ *ibid.*, 27-29

problem, spanning the width of the technological range of mine development from before the First World War to 1991.

Mine countermeasures operations are integral to successful maritime operations which employ supporting arms. Mines can be used as a primary means to engage shipping, or they can be used to funnel those forces into areas where they can be engaged by other defensive weapons. Another example of effective Iraqi shaping operations, and the inability of U.S. MCM forces to counter them, was the cruise missile attack directed at USS Missouri (BB-63). On 25 February 1991, the Missouri engaged in naval gunfire support (NGFS) in the Northern Persian Gulf and was screened by U.S. and Royal Navy escorts. The escorts were not properly positioned to provide AAW protection to her due to the suspected location of minefields. During this NGFS mission, the Iraqis fired an Silkworm anti-ship cruise missile. The missile actually overflew Missouri (believed to be a guidance system failure) and was destroyed by HMS Gloucester.²⁷ One major conclusion should be drawn from this incident: "[T]he threat is the overall enemy defense, not just the mines."²⁸

On another occasion during lead through operations in another portion of the northern Persian Gulf operations area, TF-151 received reports of the Silkworm missile launch. In response, all of the mine clearance vessels discontinued operations and rushed for safety behind combatant escorts. Surface combatants were assigned protection roles in consonance with NWP 3-09.11M *Supporting Arms in Amphibious Operations*, which states that "Protection from shore battery and air attack must be furnished by ships

²⁷ *ibid.*, 36

²⁸ Fleet Marine Force Reference Publication (FMFRP) 14-25, *A Concept for Mine Countermeasures (MCM) in Littoral Power Projection* (Quantico, VA: U.S. Marine Corps Combat Development Command, 14 February 1995), 4

whose primary mission is gunnery."²⁹ The vulnerability of surface mine countermeasures vessels effectively stalled any forward movement of the battle group, and as such deprived the battle group commander of one of the principle features of naval forces, that of rapid maneuver.³⁰ The results of this most recent combat experience can be succinctly stated: The presence of mines in the previous three cases prevented an amphibious assault, stalled the forward movement of a battle group, damaged two warships, and permitted the successful targeting and engagement of a capital ship with anti-ship cruise missiles.

The difficulties encountered during operations to clear an amphibious operation area during the Gulf War illustrate the inadequacy of Cold War doctrine in a contemporary conflict. The types of assets available were representative of antiquated operational concepts and were of little operational value to the operational commanders. The missions required for MCM forces changed, but the operational concepts and the technology procured to support those concepts were stagnant. The doctrine for MCM employment must evolve with the concept of operations for Naval and Marine forces. MCM doctrine must be cognizant of contemporary technology, but most importantly, must drive the development and procurement of future technology to match conceptual objectives.

²⁹ Naval Warfare Publication (NWP) 3-09.11M (Formerly NWP 22-2), *Supporting Arms in Amphibious Operations* (Norfolk, VA: Department of the Navy, March 1995), F-11

³⁰ CAPT P.W. Bulkeley, USN, Director, Strategy and Concepts Naval Doctrine Command, interviewed by author, 18 September 1996.

CHAPTER 2

EXPEDITIONARY WARFARE CONCEPTS

The decline of the Soviet Bloc and the experiences of the Gulf War provide impetus to the changing focus of naval forces. The recognition of the littorals as a primary theater for future operations has given rise to three naval strategy documents that chart the course to the future, ... *From The Sea, Forward* ... *From The Sea*, and *Operational Maneuver from the Sea*. Succinctly stated, "The new direction for the Naval Service remains focused on our ability to project power from the sea in the critical littoral regions of the world."¹ The role MCM forces must play if expeditionary warfare concepts are to be successful is that of an enabler, fully integrated conceptually and operationally into battle groups and operating forces. The purpose of the expeditionary warfare concept is to support the National Military Strategy of overseas presence and power projection.² The presence of combat troops embarked on amphibious shipping off foreign shores is power perceived, a feature of overseas presence. The insertion of those combat troops ashore is power achieved, a feature of effective force projection. The ability of naval forces to achieve the larger purpose of the National Military Strategy depends heavily on the full integration, at all levels, of Navy and Marine assets. The tendencies of the naval service to devise service unique solutions to MCM problems must

¹ Department of the Navy, *Forward...From The Sea*, White Paper (Washington, D.C.: Office of the CNO, March 1994), 8 (Signed by both CNO and CMC)

² Chairman of the Joint Chiefs of Staff, *National Military Strategy of the United States of America* (Washington D.C.: GPO, 1995), ii

be circumvented and replaced with a combined developmental process that drives MCM solutions toward a common objective. The method that could achieve that end is a coherent Naval doctrine "Composed of 'shared convictions' that guide naval forces as a whole, [and] fuses our service-unique tactics , techniques, procedures, and warfighting philosophies."³

Since the conclusion of the Gulf War the Navy has published several authoritative documents that purport to guide naval MCM operations. These publications include such titles as *Mine Warfare Plan: Meeting the Challenges of an Uncertain World* (1992), *Mine Warfare Campaign Plan* (1995), and *Concept of Operations for Mine Countermeasures in the 21st Century* (1995). Generally, much of the direction in these publications is very similar, but universally fails to address fully the mine countermeasures and in-stride breaching capabilities and concerns of the Marine Corps. The missing keystone, past and present, is a coherent Naval MCM doctrine for all Naval forces. A comprehensive understanding of this issue is reflected in Naval Doctrine Publication 1, *Naval Warfare*, which states that:

Naval doctrine forms a bridge between the naval component of our nation's military strategy and our tactics techniques and procedures, such as those found in our Naval warfare Publications and Fleet Marine Force Manuals.⁴

The evolution of the naval maritime strategy to encompass expeditionary warfare concepts recognizes that:

³ Naval Doctrine Publication 1, *Naval Warfare* (Washington, D.C.: Department of the Navy, 28 March 1994), 51

⁴ *ibid.*, ii

The demise of the Warsaw Pact and the Soviet Union, coupled with recent mine crises in the Middle East, have altered the paradigm by which we have structured our mine countermeasures requirements and concepts of operations.⁵

The difficulty will be to avoid reacting to the mine threats represented in the Persian Gulf by seeking technological solutions to conceptual problems. This type of approach, which has plagued MCM development for many years, is analogous to an inept physician treating a patient's symptoms without regard to the disease. Now, an opportunity presents itself to develop a concept to integrate fully all naval MCM forces and direct the research and development of technology in an appropriate direction. NDP-1, *Naval Warfare*, articulated such a premise: "Success in naval warfare is founded on properly applying sound doctrine and understanding the principles of war."⁶

The propensity of the Navy to build MCM forces and systems to react to past threats is the legacy that has created the small, contemporary force structure of MCM-1/MHC-51 class MCM vessels, MH-53E AMCM aircraft, and EOD/SPECWAR units.⁷ The sea change in military strategy forced by the end of the Cold War brings into sharp focus several significant shortfalls in MCM operations. Contemporary MCM forces continue to be "the result of the policies of the previous decade which favored using complex technologies to overcome perceived military shortcomings in East--West competition."⁸

⁵ CNO, *Mine Warfare Plan: Meeting the Challenges of an Uncertain World*, 36

⁶ NDP-1, *Naval Warfare*, 50

⁷ Current force structure and capabilities are discussed in Appendix C of this paper.

⁸ Gene I. Rochlin, and Chris C. Demchak, *Lessons of the Gulf War: Ascendant Technology and Declining Capabilities* (Berkeley: University of California, 1991), 9

Policies and concepts which were intended to counter a blue water threat present significant shortfalls for an organization with an expeditionary mission. Unfortunately, the employment which is envisioned for naval MCM forces is very reminiscent of the Cold War. What are these taskings at the end of this century? These are stated in *Mine Warfare Plan: Meeting the Challenges of an Uncertain World*, which enumerated the new priorities: ensuring the security of U.S. ports, foreign port mine clearance tasking, clearance of straits, choke points and forward operating areas, and finally conducting MCM operations in Amphibious Operating Areas (AOAs).⁹

Expeditionary forces seeking to project power ashore must cope with a new landscape. MCM operations must encompass a variety of water depths and contend with a complex and deadly mixture of mine variants. Illustrated examples of these are represented in figures II-1, and II-2. The shallow water (SW) region lies between the 200 to 40 foot water depth. Very shallow water (VSW) spans the 40 to 10 foot depth, and the surf zone (SZ) transits from 10 feet of water to the high water mark on the beach. One additional point must be stressed: MCM operations *do not stop at the high water mark*. Effective MCM operations must continue across the beach to craft landing zones (CLZs) and into the objective area.¹⁰

⁹ CNO, *Mine Warfare Plan: Meeting the Challenges of an Uncertain World*, 37-38

¹⁰ Logicon Syscon Corporation, *Integrated Amphibious and Mine Warfare Operational Concept for the year 2010* (revision 1), Exploratory Development Concept Paper produced for Naval Surface Warfare Center, Dahlgren, VA. Contract No. N60921-91-C-A205/525. 30 May 1996, 1-2

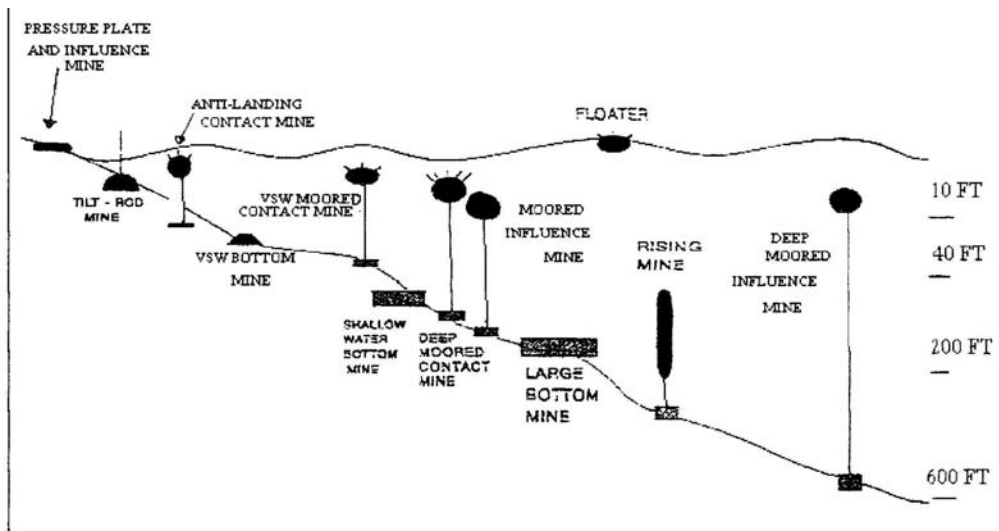


FIGURE II-1 (SW GEOMETRY)¹¹

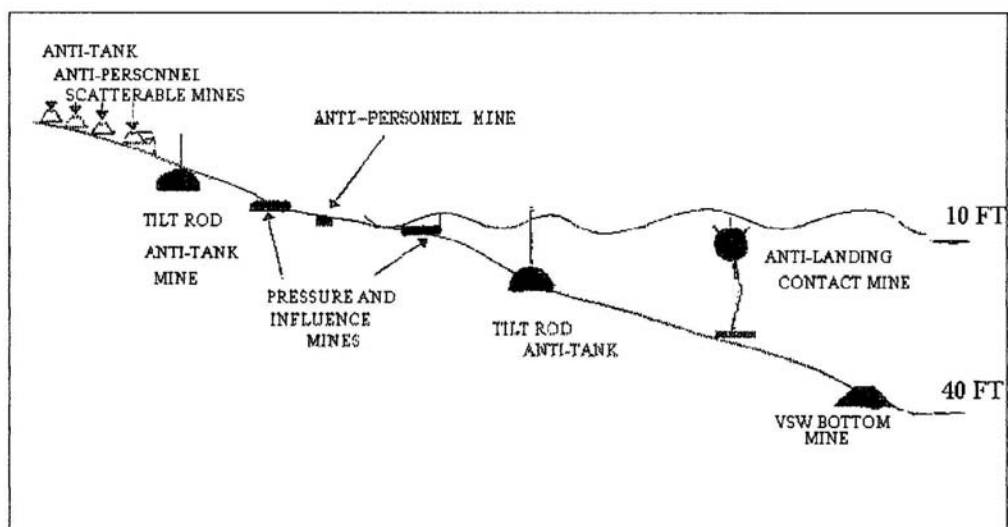


FIGURE II-2 (VSW GEOMETRY)¹²

¹¹ TACMEMO PZ6057-1-95, *Amphibious Operations in a Mine Environment*, 2-2,

2-3

¹² *ibid.*, 2-2, 2-3

The sequencing through varying water depths and across the beach must be enabled by a commonality of effort and purpose. *Mine Warfare Plan: Meeting the Challenges of an Uncertain World* makes a key point: "MCM operations are always part of the "offensive" -- either proactive or enabling -- missions of the Navy".¹³ To this end, rapid improvements must be made to doctrinal concepts and command and control procedures of existing mine countermeasures assets to fully support a seamless integration of Navy and Marine Corps initiatives for amphibious littoral operations.

REQUIREMENTS AND CAPABILITIES

Shortfalls in capabilities exist in areas of sensors and reconnaissance, as well as clearance and sweeping methods. Surface MCM vessels are hampered by a lack of environmental sensors such as weather observation equipment, sonar in-situ mode assessment systems, and sonar range prediction models. Aviation MCM assets are constrained by a lack of night operations capability. There are no in-water optic sensors fielded and no clandestine capabilities for very shallow water reconnaissance. This issue is exacerbated by limited very shallow water environmental surveys/databases for most of the world's littoral regions. Sweeping and clearance methods are similarly hampered by a limited buried mine detection capability, no close--tethered mine mechanical sweep, and no pressure mine sweep.¹⁴ There is some disparity between the *Mine Warfare*

¹³ CNO, *Mine Warfare Plan: Meeting the Challenges of an Uncertain World*, 39

¹⁴ Director, Expeditionary Warfare Division (N85), Office of the CNO Briefing, *Mine Warfare Campaign Plan*, 13 December 1995, slide 13

Campaign Plan and Joint Publication 3-15, *Joint Doctrine for Barriers, Obstacles, and Mine Warfare* which observes:

At present, the only method capable of activating a sophisticated pressure mine is the use of an actual ship. This is not a practical, routine, sweep method; however, most pressure mines are encountered in very shallow waters and are susceptible to minehunting.¹⁵

The disparity between the two publications regarding pressure mine sweep capability is probably one of semantics. Clearly, it is not feasible to sacrifice a ship to sweep a mine, because if the ship detonates a mine and sinks or is disabled it effectively creates an obstacle that must be moved or breached. The closing statement about pressure mines in very shallow water is inaccurate. The U.S. possesses little capability for minehunting in very shallow water, especially for buried mines. The problem continues to grow in complexity in the surf zone "in which conventional mine countermeasures have very limited or no capability."¹⁶

Shortfalls in capabilities are as disruptive to joint force operations as they are to Navy/Marine operations. *Mine Countermeasures: A Fighting Concept for the 21st Century* raises a critical concern regarding interoperability of forces:

Our current mine countermeasures (MCM) capabilities are limited by an inadequate integration and coordination of assets within a JTF, minimal reconnaissance means (especially clandestine), a lack of an organic in-stride breaching capability, and operational pauses created by the slow deliberate nature of MCM clearing operations."¹⁷

¹⁵ Joint Pub 3-15, *Joint Doctrine for Barriers, Obstacles, and Mine Warfare* (Washington, D.C.: Office of the Chairman The Joint Chiefs of Staff, 30 June 1993), IV-12

¹⁶ LtCol Dan Brush, USMC and David Tubridy, "Assault Breaching Tool Box Development", *Surface Warfare*, Vol. 21, No. 4, July/August 1996, 14

¹⁷ *Mine Countermeasures: A Fighting Concept for the 21st Century*, 5

The dichotomy between the requirement for rapid movement ashore and slow deliberate MCM operations signals a shift in focus to in-stride breaching techniques. This shift in focus is recognized in Joint Pub 3-15, *Joint Doctrine for Barriers, Obstacles, and Mine Warfare* which observes: "Therefore, MCM activity in amphibious operations will probably focus more on rapid "brute force" lane-breaching techniques than on conventional MCM procedures."¹⁸

CHAPTER 3

TECHNOLOGY AND FORCE STRUCTURE

U.S. Naval mine countermeasures operations have failed to develop in consonance with the expeditionary focus articulated by the Navy White Papers, *Forward . . . From the Sea*, and the Marine Corps Concept Paper, *Operational Maneuver from the Sea*. The recurrent themes of failure, particularly the fragmentary development of technology without a doctrinal focus, continue to isolate MCM forces from the operational forces they serve. The paradigm of naval MCM continues to constrain the evolution of MCM forces into an expeditionary warfare posture. Technology can provide many solutions to the shortfalls discussed earlier, but not in a reactionary application: rather, the focus must be on a new perspective for how forces are organized and what tasks are performed. The traditional viewpoint of MCM must be abandoned. *Operations In The Littoral* addresses this key point:

The comfort of orthodoxy constrains programmatic and tactical thinking, as well, too often seeing technological developments as new tools to do old jobs better, rather than as tools to redefine what jobs are done, by whom, and how.¹

If the recurrent themes of MCM failure are to be overcome, then the paradigm

¹ Naval Doctrine Command, *Operations in the Littoral*, Naval Doctrine Command Concept Paper, (Norfolk, VA: Naval Doctrine Command, 1996), 9

that has stymied the evolution of MCM forces must be broken. Unfortunately, the understanding articulated in NDP-1 *Naval Warfare*, that "Doctrine is the underlying philosophy that guides our use of tactics and weapons systems to achieve a common objective"² is not fully realized in many contemporary operational concepts.

The current mine warfare concept of operations articulated in the *Mine Warfare Campaign Plan* includes a four stage concept of operations hierarchy that transitions from peacetime to conflict. These stages include survey, mapping and intelligence; surveillance; organic MCM; and dedicated MCM. The supporting infrastructures that provide a lockstep development method for this concept of operations begins with intelligence and analysis with foreign mine exploitation. Step two of the process is preliminary tactics and doctrine. Step three is composed of war gaming and modeling and simulation, followed by fleet exercises in step four. Step five provides proven tactics and doctrine. A graphical representation is provided as figure III-1.

² NDP-1, *Naval Warfare*, 51

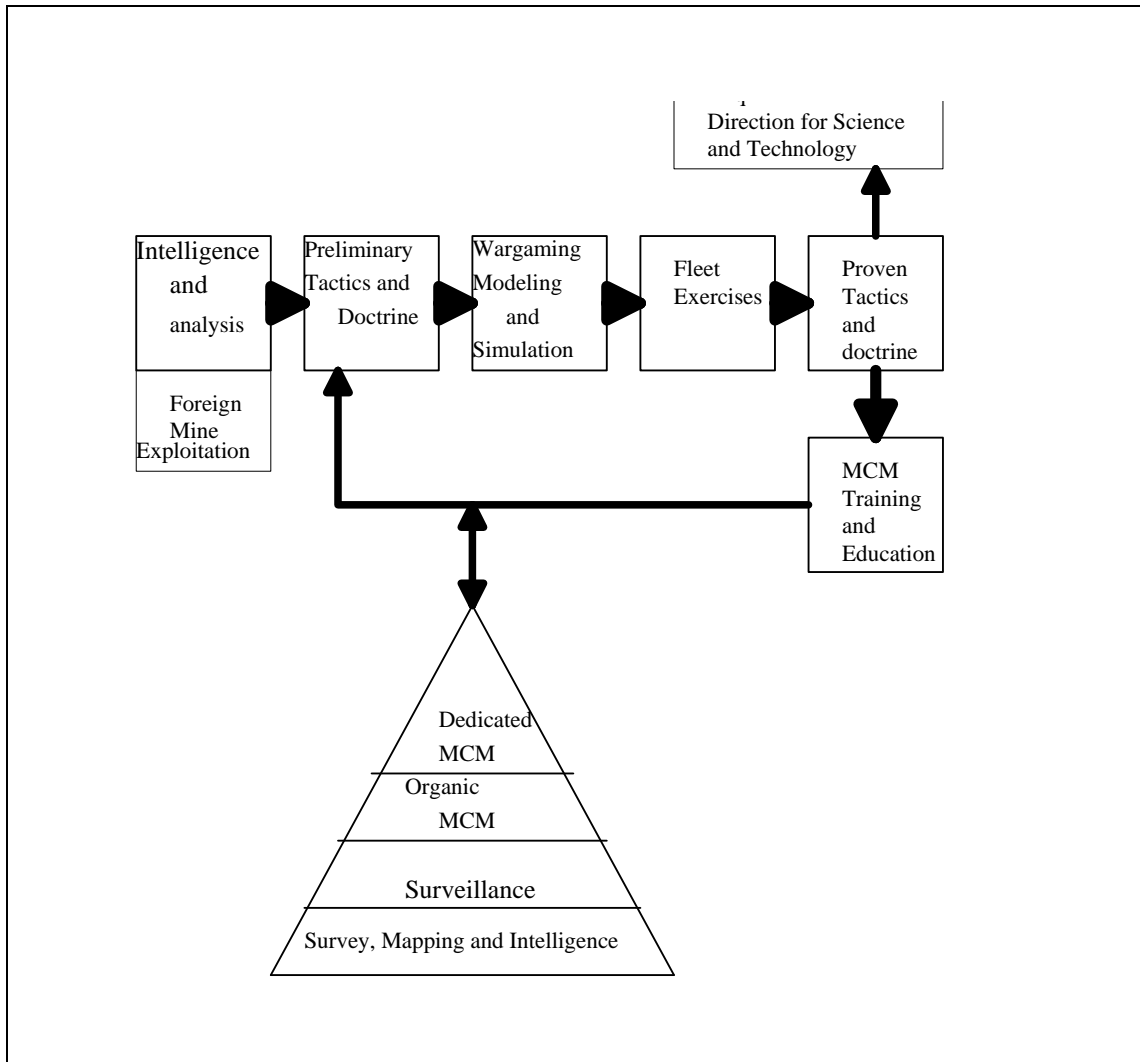


FIGURE III-1 Supporting Infrastructures³

This thought process identifies partially the historical difficulty in developing a coherent doctrine that drives tactics and technology. The process proposed in the foregoing is based on past and present threats, as evidenced by the initial activities of the process. This approach, of reacting to individual threats, outside of the larger context of

³ *Mine Warfare Campaign Plan*, slides 11-13

force employment is a theme that has plagued MCM force structure development for many years. Additionally, it should be observed that any doctrine derived from past intelligence analysis and exploitation is backward looking from the outset. Developing doctrine to meet a current or historical threat will obviate any possibility of a comprehensive, forward-looking approach to mine countermeasures. This developmental process illustrates a flawed approach that gives growth to the recurring theme of operational concepts that are driven by technology. This reverses the process, which should be doctrinal precepts which are then supported by technology.

TECHNOLOGICAL ADVANCES

The introduction of Global Positioning System (GPS) hardware represents one of the most significant enhancements to mine clearance operations in recent history. The ability to precisely fix a geographic point through a shared common relationship with other assets provides a capability for detailed mapping of mine-like contacts. This revolutionary capability is essentially ignored by current operational procedures that continue to rely on primitive methods of buoy marking for mine-like contacts and transit lanes. The time savings for marking contacts and transit lanes electronically rather than the time intensive method of manually laying buoys to mark the same contact or transit lane would be significant. The same concept of using GPS data to vector EOD teams to a suspected mine would also greatly enhance the speed of prosecution.

Contemporary training methods for surface MCM vessels vectoring EOD teams

in a small boat is to range a mine-like contact by sonar and compare the location to the location of a metal sphere called a "Diablo" suspended into the water from the small boat. The surface MCM vessel then directs the EOD team by voice radio commands by resolving the position differences between the Diablo and the mine-like contact. Clearly, a much more rapid method would be to download the contacts GPS position to a handheld GPS transceiver and let the EOD team drive to the waypoint. This capability exists, as global positioning system hardware is widely installed on units throughout the fleet, including MCM units.

The introduction of digital data link capabilities for inter-unit coordination has provided enhanced methods for command and control. Unfortunately, none of the current US mine countermeasures assets have any type of data link capability, or any high speed method for sharing position information with any other unit. Tactical data link systems are fairly mature technologies and many of the systems currently in use in the fleet have been operational for over a decade. A representative sample of mature technology shortfalls in MCM forces include digital secure voice, officer in tactical command information exchange network (OTCIXS), tactical information exchange system, (TADIX A), and tactical intelligence data system (TACINTEL).⁴

The lack of mature technologies installed in MCM units is symptomatic of the recurring theme of failures to integrate MCM forces into the operating forces. The building and procurement programs that provided the current mix of MCM units apparently did not envision these units as integrated parts of a battle group or naval

⁴ Program Executive Office Mine Warfare, *Mine Warfare (MIW) C4ISR Systems Architecture* Working draft funded by PEOMINWAR, 31 August 1996, 3-9

expeditionary force. Consequently, the construction and outfitting cycles failed to provide for the basic equipment required to function as an integral part of the larger force structure.

Perhaps the most troubling aspect is the omission of a reliable long haul communication system for surface MHC vessels. Surface MHC vessels are outfitted with a limited number of antiquated high frequency (HF) transceivers. This communication method is not frequently used in the operating forces, and surface MHC vessels are faced with great difficulty in communicating effectively over long distances. This significant shortfall continues to be a high priority for correction in the operating forces directed by Commander, Mine Warfare Command.⁵

The lack of interoperability of forces is not limited to operations between MCM forces and battle groups. Difficulties are also resident in the interoperability of individual types of MCM assets. It is not possible to directly share or exchange data between the MCM-1 class ship outfitted with the SSN-2 Precise Integrated Navigation System (PINS), and the MHC-51 class ship outfitted with the AN/SYQ 13 navigation/command and control system. The only method for transferring data between these two units is to make a voice report or transmit a hard copy message. Similarly, it is not possible for either of the two ship classes to directly transfer data with AMCM MH-53E aircraft. The inability to rapidly transfer position and location data between units creates an operational pause during a turnover of efforts during MCM operations. The problem is magnified at the command level, as the Mine Warfare (MCM) Commander must collate

⁵ LCDR Robert McGrath, USN, Operations Officer (N3), Commander, Mine Warfare Command, telephone interview by author, 16 September 1996.

and display all of the locating information to develop a complete picture of the battle space.

The critical issue for expeditionary warfare missions is to continually recognize that the battle space covers more than just the fluid medium, for it continues across the beach to the objective. The MCM commander must remain cognizant that "analysis of current mine threat data and map reconnaissance of critical zones are keys to mission planning."⁶ The command and control problem becomes increasingly complex as operations transition into the joint arena. As remarked on in *Mine Warfare (MIW) C4ISR Systems Architecture*, "... in addition, the MIW Commander must be able to share a MIW-oriented subset of the Joint Force C4I information set with the MIW-specific platforms."⁷ A comprehensive effort must be made to modernize mine countermeasures doctrine in consonance with the expeditionary focus of the Navy White Paper, *Forward . . . From The Sea*, and the Marine Corps Concept Paper, *Operational Maneuver from the Sea*. *Operations in the Littoral* identifies a basic paradox that must be conceptually resolved:

Technology is creating problems and opportunities. Systems are too often developed on a stand-alone basis, in scenarios designed to emphasize individual systems or missions, devoid of a larger context.⁸

⁶ Belvoir Research, Development, and Engineering Center Countermines Systems Directorate (BRDEC) Pamphlet 350-1, *Mine/Countermines Guide for Low Intensity Conflict Environment in Central America*, (Fort Belvoir, VA: Belvoir Research, Development, and Engineering Center, March 1989), 80

⁷ *Mine Warfare (MIW) C4ISR Systems Architecture*, 3-10

⁸ *Operations in the Littoral*, 9

The United States military has been highly successful in harnessing technology to provide proper solutions to complex problems. The technological issues discussed in the foregoing can be resolved, and the means to allow MCM forces to operate with each other, as well as larger force structures, are within current capabilities. However, once the hardware issues are resolved there remains a basic problem: how to train an entire community, SMCM, AMCM, and EOD units, to operate with battle groups and amphibious groups with which they have had little historical experience.⁹ Aligning the training cycles of the MCM forces with that of the battle groups and amphibious groups that they are expected to support, whether they actually deploy or not, would serve to increase the interoperability of those forces. A common training and workup cycle would address the historical shortfall discussed in *Mine Warfare Plan: Meeting The Challenges of an Uncertain World*. This publication noted that,

... our MCM forces have only rarely conducted coordinated MCM exercises with the battle groups and amphibious groups that they could be called upon to support.¹⁰

⁹ CNO, *Mine Warfare Campaign Plan: Meeting The Challenges of an Uncertain World*, 71

¹⁰ *ibid.*, 71

CHAPTER 4

MAGTF INTEGRATION

Complementary training initiatives that encompass doctrine as well as tactics, techniques, and procedures must be developed in consonance with technology employed to support expeditionary warfare concepts. These training initiatives should recognize the high degree of cooperation and commonality of effort required to achieve clearance objectives for force insertion. The opportunities to facilitate these initiatives have been greatly enhanced by organizational and institutional improvements in the mine warfare organization since the close of the Gulf War.¹

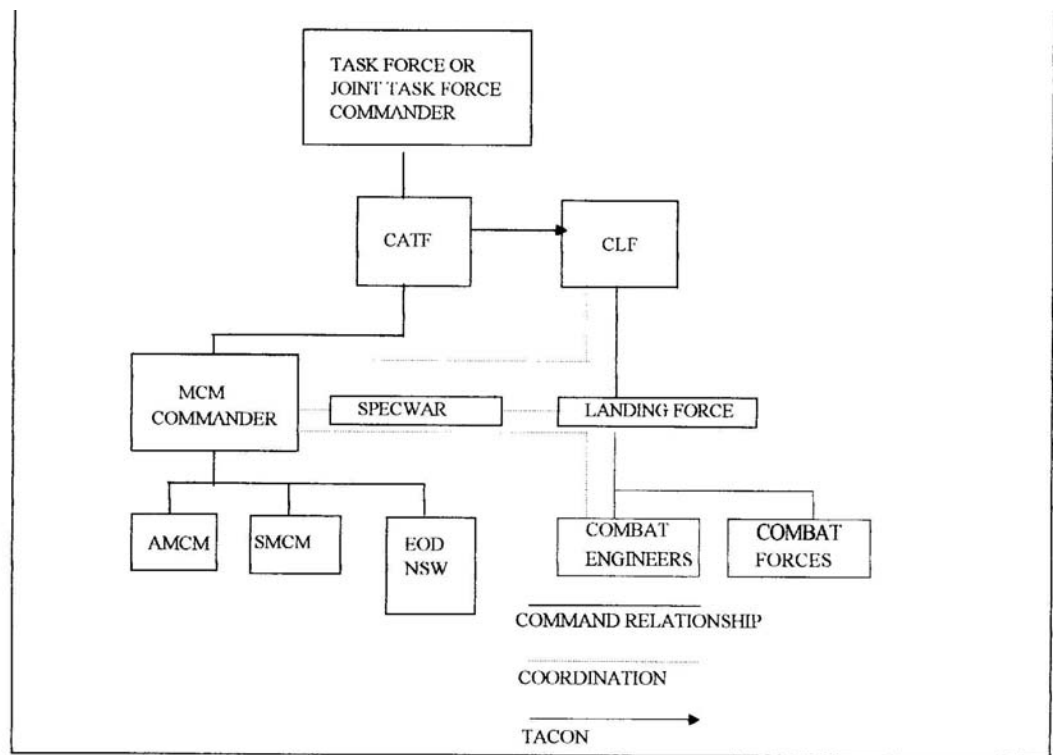
Organizational effectiveness has been enhanced by designating the, Commander, Mine Warfare Command, as an operational commander with cognizance over all mine warfare assets in the US Navy. Institutionally, operational effectiveness has been enhanced by the creation of deployable MCM staffs. MCM squadrons ONE and TWO provide two fully deployable operational staffs, with expertise in surface, air, and EOD aspects of mining and mine countermeasures. This is a significant improvement over past procedures in which control of MCM operations was generally a collateral duty of a battle group staff, or an *ad hoc* organization such as the U.S. Mine Countermeasures

¹ CNO, *Mine Warfare Plan: Meeting the Challenges of an Uncertain World*, 66-72

Group (USMCMG) formed during Operation *Desert Shield*.

These organizational and institutional improvements can greatly enhance the effectiveness of amphibious operations.² Current amphibious doctrine, Joint Publication 3-02, *Joint Doctrine for Amphibious Operations*, recognizes the relationships of the Commander, Amphibious Task Force (CATF), and the Commander, Landing Force (CLF) as illustrated in figure IV-1.³

FIGURE IV-1 (CATF and CLF relationship)⁴



² CNO, *Mine Warfare Plan: Meeting the Challenges of an Uncertain World*, 67-72

³ Joint Pub 3-02, *Joint Doctrine for Amphibious Operations*, (Washington, D.C.: Office of the Chairman The Joint Chiefs of Staff, 08 October 1992), II-9 - II-13.

⁴ *Amphibious Operations in a Mine Environment*, 3-3

The reporting relationship for the MCM commander is particularly germane to the foregoing discussion of organizational improvements.

The capability of a trained MCMRON staff to deploy as part of an amphibious task force as an MCM commander provides a new level of capability to the CATF and CLF. This capability poses a new question for achieving a better integration of Navy and Marine MCM efforts. Which commander (CATF or CLF) is most appropriate for the MCM commander to report? This command reporting relationship issue is also resident in the evolving concept of the Naval Expeditionary Task Force (NETF). The Naval Expeditionary Task Force command and control concept is an evolutionary one which seeks to reconcile Navy operational issues with the precepts of *Operational Maneuver From The Sea*.⁵ This reporting relationship issue will be developed in the following discussion of NETF command and control, recognizing that the central point is to devise a method in which the forces going ashore do not suffer an institutional operational pause.

MCM COMMAND AND CONTROL

The concept of the NETF seeks to propose a command and control method in which a battle group and an amphibious group could be integrated into a single entity. The method of achieving this integration would be to build on the composite warfare commander concept, redesignating the CLF as the Landing Force Component

⁵ Naval Doctrine Command (COMNAVDOCCOM), *Naval Expeditionary Task Force Command and Control* (Norfolk, VA: Naval Doctrine Command, 01 July 1996), 3-1-1

Commander (LFC). The traditional responsibilities of the CATF are performed by the Commander, Naval Expeditionary Task Force (CNETF) if the entire NETF is involved, or by the Amphibious Warfare Commander (AMWC) if only the amphibious and landing forces are involved.⁶

Embedded within the concept of the Naval Expeditionary Task Force command and control structure is the Mine Warfare (MIW) Commander, replacing the term MCM commander. The MIW commander is directly responsible to the Commander, Naval Expeditionary Task Force (CNETF) for planning and conducting mine warfare activities within the area of operations (AO). These activities are envisioned to include offensive and defensive mining, as well as mine countermeasures in deep and shallow water, up to the high water mark and into craft landing zones (CLZs).⁷

What is noticeably absent is the idea of ship to objective maneuver. This concept has a built in operational pause in that it fails to address the seamless transition of mine countermeasures from sea to shore. If the MIW commander is responsible for the operational area seaward into the high water mark, who then would be responsible for MCM operations across the beach to the objective? This issue is particularly critical as the size of the operations area becomes increasing large for over the horizon operations, and the requirement for speed and maneuver become the determining factors for mission success. If the NETF is to achieve a rapid breach or insertion, it can ill afford to suffer an operational pause for a shift of effort for MCM activities. If there is an institutional disconnect that causes an operational pause in the sequencing of forces, then it is not

⁶ *ibid.*, 3-1-1 - 3-7-1

⁷ *Naval Expeditionary Task Force Command and Control*, 3-6-1

possible to achieve the fundamental requirement detailed in *A Concept for Mine Countermeasures (MCM) in Littoral Power Projection*: that "Surprise, speed and momentum are critical to successful power projection."⁸

SEAMLESS INTEGRATION OF ALL MCM ASSETS

For a Command and Control concept to be successful for expeditionary forces, it must consider all aspects of naval forces. *Mine countermeasures is not a Navy only endeavor*. The Marines, or any landing force, must deal with a variety of mines⁹ from the point that Navy assets stop until the objective is reached. To be valid, any expeditionary doctrine must take into account the capabilities and shortfalls of all naval MCM forces and seek to seamlessly integrate them in a command hierarchy that is appropriate to the task. The difficulty in developing a useful command and control system is the conceptual paradigm that has constrained the evolution of Naval MCM doctrine and is illustrated in *Focus on the Littorals*, which observes that:

Clearly, one of the major conceptual challenges in coming years will be the development - and implanting in the mainstream of air, surface, and submarine warfare communities -- of an integrated doctrine linking the increasingly varied mine warfare areas of intelligence/surveillance, organic MCM (on ships, helos, MCMVs) and dedicated MCM (both U.S. forward deployed units, as in the

⁸ FMFRP 14-25, *A Concept for Mine Countermeasures (MCM) in Littoral Power Projection*, 13

⁹ *Mine/Countermine Guide for Low Intensity Conflict Environment in Central America*. This publication gives a good overview of the types of land mines that may be encountered on the beaches and inland approaches. A representative sample of both manufactured and "homemade" mines are discussed.

Arabian Gulf now, as well as coalition capabilities).¹⁰

What is most noticeable in the foregoing is the complete absence of the capabilities and focus of the Marine Corps. If naval forces are to ever develop a viable doctrine, and subsequently a command and control system to execute that doctrine, there must be a recognition that "the increasingly varied mine warfare areas"¹¹ includes as a full participant the Marine Corps, and in some cases may include the U.S. Army.¹² Ideally, there would be no discernible point where USN MCM efforts stop and Landing Force MCM efforts begin. This is the major conceptual challenge in coming years.

The development of hardware and technology is incidental to the conceptual framework of a command and control architecture. A command and control system should be defined by the doctrine it serves and not by the tactics, techniques, and procedures (TTP's) that it directs. The Naval Doctrine Command provides a clear conceptual linkage regarding doctrine and TTPs; as Dr. James Tritten wrote in 1996:

The Naval Doctrine Command does not intend that doctrine replace the word tactics nor that naval doctrine extend into the tactical-level of warfare other than to shape and guide multi-service naval or Navy and Marine Corps individual Service TTP.¹³

An appropriate command and control system for expeditionary forces would be focused on naval doctrine and serve as an enabler for the execution of TTPs. Naval

¹⁰ *Focus on the Littorals*, 27-28

¹¹ *ibid.*, 27-28

¹² Joint Pub 3-02, *Joint Doctrine for Amphibious Operations*, II-9

¹³ James J. Tritten, *Naval Perspectives for Military Doctrine Development*, Research paper. Joint Electronic Library CD-ROM, September 1996, 16

expeditionary forces should be served by a command and control architecture that functionally recognizes the littoral as the battlefield, with the struggle ashore as the ultimate focus of every commander's efforts and attention."¹⁴ To this end reporting relationships and command hierarchies should be designed to minimize operational pauses, and achieve full integration of assets. This concept is particularly critical to MCM operations where it is noted that "while the *requirement* for rapid, clandestine, and in stride MCM operations has increased, the *capability* to conduct these operations has not kept pace."¹⁵

In the development of command hierarchies a greater focusing of effort could be achieved by making the MIW commander a subordinate of the MAGTF commander. This is illustrated in figure IV-2.

¹⁴ *Operations in the Littoral*, 9

¹⁵ *Mine Countermeasures: A Fighting Concept for the 21st Century*, 7

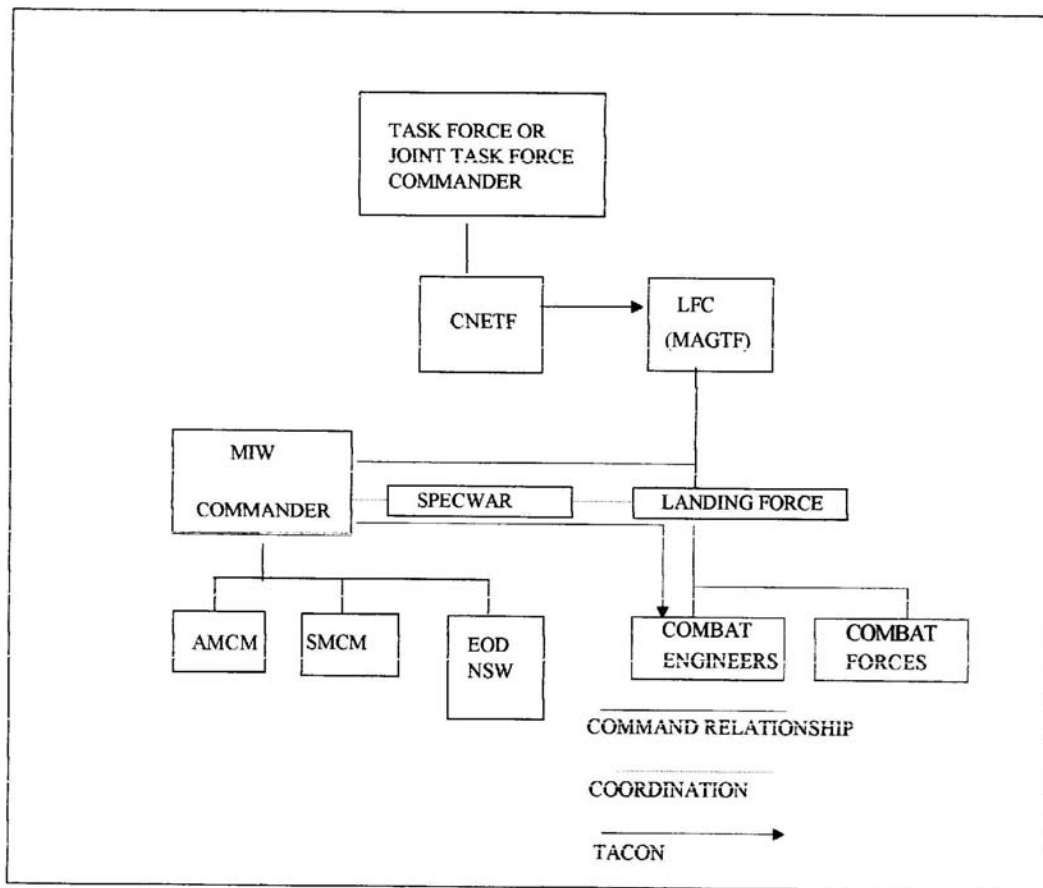


FIGURE IV-2 MAGTF and MIW Integration

The conceptual paradigm of separate efforts could be obviated, and MCM could become complementary and sequential activities, as opposed to the syncopated and disjointed methods currently employed. Placing the MIW commander in the MAGTF command hierarchy would force the development of technology and hardware command and control system components to provide for exchange of position and locating data for mines, and increase the drive for complementary clearance methodologies. "This means that the operating parameters of MCM systems must be commensurate with those of the

assault elements that they accompany."¹⁶ A single naval MCM organization, working for and through the focus of the power projection effort, would be institutionally forced to recognize that "A common situational awareness of the amphibious operating area is essential and must be disseminated by and to staff (intelligence/operations) levels."¹⁷

The alignment of the MIW commander under the MAGTF commander would be consistent with the desire that "Doctrine should support all facets of forward deployed naval operations in the littoral."¹⁸ This concept would also instigate change to the paradigm of naval MCM forces as specialty forces by forcing a greater integration of all naval MCM forces into a NETF. Finally, this command relationship would be consistent with *Naval Expeditionary Command and Control* which states: "Whether the entire NETF is involved or the ARG/MEU(SOC) conduct the operation separately, the CNETF designates the LFC the supported commander and places remaining commanders in direct support."¹⁹

Certainly there are arguments against aligning the MIW commander under the MAGTF commander. An argument could be made that if there is no landing force mission requirement for the NETF, why should the MIW commander remain in this chain of command? The response is that if there is no landing force mission then consequently there is no mine clearance/breaching mission to be performed. If the only MCM

¹⁶ FMFRP 14-25, *A Concept for Mine Countermeasures (MCM) in Littoral Power Projection*, A-6

¹⁷ Commander Surface Warfare Development Group (COMSURFWARDEVGRU) TACMEMO PZ6057-1-95, *Amphibious Operations in a Mine Environment*, (Norfolk, VA: COMSURFWARDEVGRU, 15 December 1995), 2-7

¹⁸ *Naval Expeditionary Task Force Command and Control*, 3-1-1

¹⁹ *ibid.*, 3-1-3

missions that are envisioned are those in support of blue water NETF operations, then the MIW commander would revert to reporting directly to the CNETF, who is the focus of effort in that instance. The central issue for this proposal is that the reporting relationships should be commensurate with the focus of effort, and if that effort is to land the landing force then the most appropriate superior for the MIW commander is the MAGTF commander.

CHAPTER 5

CURRENT AND FUTURE DOCTRINE DEVELOPMENT

The US Navy has dealt with the problem of mines with varying degrees of success for well over 100 years. In virtually every theater of war the Navy has been reminded that "[M]ines thus can constrain naval operations and generate an extremely impressive "force multiplier" effect all out of proportion to their costs."¹ Mines pose more than just a threat to power projection; they also represent a threat to force protection as well. This issue is not solely a maritime problem, for it also troubles ground forces as well, constraining ground combat operations and reordering priorities.

Improvements in organizational and institutional practices as well as technological advances make the need for a single naval MCM doctrine very compelling. The critical vulnerability² represented by contemporary MCM forces, and from a historical perspective the ability of the nation's enemies to shape US forces at the tactical, operational, and strategic levels through the use of mines, underscore the need to revisit the fundamental requirements for MCM forces. The *National Military Strategy* provides direction for naval forces. James Tritten articulates a clear understanding of the relationships that must exist in pursuing national objectives, when he states, "[M]ulti-Service naval doctrine serves as the bridge between higher-level policy documents and strategy and TTPs."³ Most of the discussion in the previous four chapters seeks to illustrate the criticality of the linkage of strategic policy, translated by doctrine, to

¹ CNO, *Mine Warfare Plan: Meeting the Challenges of an Uncertain World*, 36

² Dr. Joe Strange, *Centers of Gravity & Critical Vulnerabilities: Building on the Clausewitzian Foundation so that We Can All Speak the Same Language*, Number Four of *Perspectives On Warfighting* (Quantico, VA: Marine Corps Association, 1996), 3

³ Tritten, *Naval Perspectives for Military Doctrine Development*, 16

develop tactics, techniques, and procedures to execute that policy. The lack of a comprehensive, coherent naval MCM doctrine is the missing link that has contributed to inappropriate force structures, employment, and operational failures.

Although the role of the Armed Forces is being reviewed in the Quadriennial Defense Review process, the current *National Military Strategy* defines the core requirement for force levels as that level sufficient to conduct two major regional conflicts nearly simultaneously. It further details the employment of this force in two strategic concepts: Overseas Presence and Power Projection.⁴ New strategies resulting from the Quadriennial Defense Review may alter force structures, and the size and number of conflicts the Armed Forces will be tasked with handling, but the strategic concepts are not likely to change. The higher-level policy document in the form of the *National Military Strategy* is quite clear in defining strategic concepts and force levels. The White Paper *Forward... From The Sea* translates the *National Military Strategy* into direction for the naval service. What remains is to create a MCM doctrine which takes direction from the higher-level policy documents of the *National Military Strategy* and *Forward... From The Sea* and gives direction for the development of tactics, techniques, and procedures, as well as the direction for research and development of technology. The recurring themes of mine countermeasures failure, lack of published doctrine, the failure to fully integrate MCM forces into the larger operating forces, and the fragmentary development of technology without the focusing element of a coherent doctrine, could then be addressed in an analytical manner to achieve the larger operational and strategic missions of the naval service.

⁴ CJCS, *National Military Strategy of the United States of America*, ii

It is questionable whether the contemporary MCM force structure of 26 surface MCM vessels, 36 AMCM aircraft, and 12 EOD detachments is sufficient to meet the current *National Military Strategy* force level requirement to conduct two major regional conflicts nearly simultaneously. The creation of two deployable MCM squadron staffs, and the forward deployment of two MCM-1 AVENGER class ships to both Japan and the Persian Gulf do represent an attempt to meet these requirements. Additionally, the forward deployment of these MCM vessels meet the strategic concept of overseas presence, but at a token level.

The greatest concern is that the force mixture will not be effective and responsive to expeditionary warfare taskings. The discussions of shortfalls in capabilities in chapter three highlight the inadequacies of the current force structure in countering MCM threats in the littorals. These issues, coupled with the inability of MCM platforms to operate as an integral part of battle groups and amphibious task forces, make the possibility for successful execution of expeditionary operations tenuous at best against a foe with a well developed defensive system, which would of course include mines. Furthermore, the mix of active and reserve assets may not provide a sufficient number of units available to sortie on short notice for contingency taskings, as more than fifty per cent of the force is in the reserves, and activation and travel time will be a factor in rapidly deploying reserve units. Fifteen of the 26 surface MCM ships, the USS INCHON (MCS-1), and 12 of the 24 AMCM aircraft are in the reserve component. This, coupled with the small size of the entire MCM force structure ensure that these force levels are not adequate to support 12 carrier battle groups and a comparable number of amphibious ready groups. This force posture is very reminiscent of the Cold War maritime strategy, and is clearly not the path to primacy in expeditionary warfare. A reassessment of force levels is necessary to

determine the viability of MCM forces to support the requirements of the *National Military Strategy*, and the White Paper *Forward... From The Sea*.

It is incumbent on the leadership of the naval service to resolve the conflicting priorities and initiatives that arise from the variety of plans, concept papers, and operational concepts published. The propensity of the service to publish varying concepts, plans and procedures dilutes the unity of effort by driving efforts in many direction at once. By way of illustration, it is useful to examine the disparity between missions and infrastructure that arises from the an example in the *Mine Warfare Plan: Meeting the Challenges of an Uncertain World*, which defines as an MCM mission priority ensuring the security of US ports.⁵ The disparity is that all of the MCM assets, both ships and aircraft, are being co-located to adjacent remote sites: Naval Station Ingleside, Texas, and Naval Air Station, Corpus Christi, Texas. Why? So as to create a "Mine Warfare Center Of Excellence".⁶ In so doing, the Navy has preempted its ability to accomplish its port security mission, as there are no MCM assets in other Navy homeports to conduct break-out or security mission. Additionally, the transit time by sea across the Gulf of Mexico to the nearest East Coast Navy port is at least five days, and considerably longer to the West Coast. A comprehensive examination of missions and infrastructures is required to align forces with mission requirements.

There are four recommendations to be made for the future development of naval MCM forces. The first is that the criticality of mine countermeasures in contemporary expeditionary warfare demands the development of a coherent doctrine to focus the integration of forces and the development of technology. To be effective, a MCM

⁵ CNO, *Mine Warfare Plan: Meeting the Challenges of an Uncertain World*, 38

⁶ *ibid.*, 69-71

doctrine development process should recognize that "[C]urrent strategy and subordinate campaign concepts clearly should have a major influence on military doctrine."⁷ This process is evident in the Marine Corps Concept Paper *Operational Maneuver from the Sea*, which proposes a conceptual approach to the evolution of amphibious doctrine. This evolving doctrine seeks to control the spatial and temporal aspects of the battlespace, and is driving the development of technology to execute the doctrinal precepts. A complementary MCM doctrine must evolve to support a force structure built on the paradigm that the " ... US Navy's continued proponency of OFMTS is critical in maintaining the capability to support future amphibious operations."⁸ This doctrine should be written by the Naval Doctrine Command in the manner in which it published NDP 1, *Naval Warfare*. Secondly, a reorganization should be instituted for the Commander, Mine Warfare Command. The results of this reorganization should yield an operational entity, Commander, Naval Mine Warfare Command, whose leadership rotates equally between a Navy Flag and a Marine Corps General Officer. The authorities of this command should be broadened to include all naval mine countermeasures activities to better achieve a commonality of purpose, and more fully integrate the two services with an expeditionary focus. Thirdly, in accordance with the precepts of *Operational Maneuver from the Sea*⁹ and the constructs of *Naval Expeditionary Command and Control*,¹⁰ the MIW commander should work for the supported commander to accomplish a ship to objective maneuver. The relationship of CATF and CLF should be revisited in

⁷ Tritten, *Naval Perspectives for Military Doctrine Development*

⁸ *Integrated Amphibious and Mine Warfare Operational Concept for the Year 2010* (revision 1), 4-3

⁹ *Operational Maneuver from the Sea*, 14

¹⁰ *Naval Expeditionary Command and Control*, 3-1-3

light of the evolving NETF concept. In consonance with this examination, the issue of reporting relationships should consider the possibility of making the CATF and CLF co-equals for planning *and execution*. Finally, the training cycles of all MCM forces, both Navy and Marine Corps, should be aligned and integrated with the inter-deployment cycles of the forces which they will support. Simply put, "[T]he US Navy must possess the best mine countermeasures capability available."¹¹

¹¹ CNO, *The United States Navy in "Desert Shield" "Desert Storm"*, vi

APPENDIX A : ACRONYMS

<u>ACRONYM</u>	<u>DEFINITION</u>
AAW	Anti-Air Warfare
AAWC	Anti-Air Warfare Commander
AFFOR	Air Force Forces
AGF	Amphibious Flag Ship
AIS	Automated Information System
AMCM	Airborne Mine Countermeasures
AO	Area of Operations
AOA	Amphibious Objective Area
ARFOR	Army Forces
ARG	Amphibious Ready Group
ASUWC	Anti-Surface Warfare Commander
ASW	Anti-Submarine Warfare
ASWC	Anti-Submarine Warfare Commander
BCIXS	Battlecube Information Exchange System
C2	Command and Control
C2W	Command and Control Warfare
C2WC	Command and Control Warfare Commander
C4I	Command, Control, Communications, Computers and Intelligence
CATF	Commander, Amphibious Task Force

CCC	CINC Command complex
CG	Guided Missile Cruiser
CINC	Commander-in-Chief
CINCLANTFLT	Commander-in-Chief, U. S. Atlantic Fleet
CINCPACFLT	Commander-in-Chief, U. S. Pacific Fleet
CJCS	Chairman, Joint Chiefs of Staff
CJCSI	Chairman, Joint Chiefs of Staff Instruction
CJTF	Commander Joint Task Force
CLF	Commander Landing Force; CINCLANTFLT
CLZ	Craft Landing Zone
CMWC	Commander, Mine Warfare Command
CNETF	Commander, Naval Expeditionary Task Force
CNO	Chief of Naval Operations
COE	Common Operating Environment
COMINEWARCOM	Commander, Mine Warfare Command
COMSPAWARSCOM	Commander, Space and Naval Warfare Systems Command
COTS	Commercial Off the Shelf
CPF	CINCPACFLT
CTF	Task Force Commander
CV	Aircraft Carrier
CVBG	CV Battle Group

CWC	Composite Warfare Commander
DD	Destroyer
DED	Data Element Dictionary
DoD	Department of Defense
DPG	Defense Planning Guidance
EOD	Explosive Ordnance Disposal
EODMU	EOD Mobile Units
FFG	Guided Missile Frigate
FMFM	Fleet Marine Force Manual
FMFRP	Fleet Marine Force Reference Publication
FOSIC	Fleet Ocean Surveillance Information Center
FOSIF	Fleet Ocean Surveillance Information Facility
GCCS	Global Command and Control System
GLOBIXS	Global Information Exchange System
GPS	Global Positioning System
HDD	Hierarchical Data Dictionary
HF	High Frequency
IER	Information Exchange Requirement
IPT	Integrated Product Team
ISR	Intelligence Surveillance

	and Reconnaissance
IW	Information Warfare
JCS	Joint Chiefs of Staff
JFACC	Joint Forces Air Component Commander
JIC	Joint Intelligence Center
JMA	Joint Military Assessment; Joint Mission Area
JMCIS	Joint Maritime Command Information System
JMO	Joint Maritime Operations
JSOTF	Joint Special Operations Task Force
JTF	Joint Task Force
LAN	Local Area Network
LCC	Amphibious Command Ship
LFCC	Landing Force Component Commander
LFSP	Landing Force Shore Party
LHA/LHD	Amphibious Assault Ship
LPD	Landing Platform Dock
LPH	Amphibious Helicopter Carrier
LSD	Landing Ship Dock
MAGTF	Marine Air Ground Task Force
MARDEZ	Maritime Defense Zone
MARFOR	Marine Corps Forces

MCAC	Multipurpose Landing Craft Air Cushion
MCM	Mine Countermeasures
MCM CDR	MCM Commander
MCMGRU	Mine Countermeasures Group
MCMMPs	Mine Countermeasures Mission Planning System
MCMRON	Mine Countermeasures Squadron
MCMV	Mine Countermeasures Vessel
MCS	Mine Countermeasures Support Ship
MEDAL	Mine Warfare Environmental Decision Aids Library
MHC	Mine Hunter, Coastal
MIC FAC	Mobile Integrated Command Facility
MIUW	Mobile Inshore Underwater Warfare
MIW	Mine Warfare
MNS	Mission Need Statement; Mine Neutralization System
MSGFMT	Message Format
NAVFOR	Naval Forces
NAVIXS	Navigation Information Exchange System
NAVSPECWAR	Naval Special Warfare
NAWG	Naval Architecture Working Group
NBFIA	Naval Battle Force Information Architecture

NCC	Naval Component Commander
NDP	Naval Doctrine Publication
NETF	Naval Expeditionary Task Force
NSW	Naval Special Warfare
NWP	Naval Warfare Publication
OMFTS	Operational Maneuver From The Sea
OPNAV	Office of the CNO
OPNAVINST	OPNAV Instruction
ORD	Operational Requirements Document
OTCIXS	Officer in Tactical Command Information Exchange System
OTHGOLD	Over-the-Horizon Gold (Message Standard)
OTHMCM	Over-the-Horizon Mine Countermeasures
PCO	Primary Control Officer
PEO	Program Executive Officer
RDIXS	Radar Information Exchange System
RFIXS	Radio Frequency Information Exchange System
RMS	Remote Mine-Hunting System
ROC	Required Operational capability
SAMS	Self Propelled Acoustic/Magnetic Minesweeping System
SC	Surface Combatant

SECDEF	Secretary of Defense
SEW	Space and Electronic Warfare
SIGINT	Signals Intelligence
SINGCARS	Single Channel Ground and Airborne Radio System
SLOC	Sea Lanes of Communications
SMCM	Surface Mine Countermeasures
SME	Subject Matter Expert
SOF	Special Operations Forces
SPAWAR	Space and Naval Warfare Systems Command
SSBN	Nuclear Ballistic Missile Submarine
SSN	Nuclear Powered Attack Submarine
STWC	Strike Warfare Commander
SW	Shallow Water
SZ	Surf Zone
TACINTEL	Tactical Intelligence Data System
TACMEMO	Tactical Memorandum
TACNOTE	Tactical Note
TAD	Theater Air Defense
TADIXS	Tactical Information Exchange System
TAFIM	Technical Architecture Framework for Information Management
TBMD	Theater Ballistic Missile Defense
TCC	Tactical Command Center

TCP/IP	Transmission Control Protocol/Internet Protocol
TDA	Tactical Decision Aid
TTP	Tactics, Techniques, Procedures
USN	U.S. Navy
USMC	U.S. Marine Corps
USMCMG	United States Mine Countermeasures Group
USMTF	United States Message Text Format (Message Standard)
VSW	Very Shallow Water
WAN	Wide Area Network

APPENDIX B: MINE TYPES¹

ACOUSTIC: A mine with an acoustic circuit responding to the acoustic (noise signature) field of a ship or sweep.

ANTIPERSONNEL: A mine designed to cause casualties to personnel.

ANTITANK: A mine designed to immobilize or destroy a tank.

BOTTOM: A mine with negative buoyancy which remains on the seabed; also called a ground mine.

COMBINATION: Any mine type with a combination of influence detonators, such as: magnetic, acoustic, seismic, or pressure.

CONTACT: A mine detonated by physical contact.

CONTROLLED: After laying, a mine controlled by the user to make the mine safe, or live, or to fire it.

INFLUENCE: A mine actuated by the effect of a target on some physical condition in the vicinity of the mine or on radiation emanating from it. This includes acoustic, magnetic, pressure, seismic, and underwater electric potential.

LIMPET: An explosive device physically attached to a ship's hull by a diver or swimmer and activated by timer or remote control.

MAGNETIC: A land or naval mine responding to the magnetic field of the target.

MOORED: A contact or influence-operated mine of positive buoyancy held below the surface by a mooring attached to a sinker or anchor on the bottom.

¹ Sources consulted include: COMSURFWARDEVGRU TACMEMO PZ6057-1-95, *Amphibious Operations in a Mine Environment*; FMFRP 14-25, *A Concept for Mine Countermeasures in Littoral Power Projection*; CNO, *Mine Warfare Plan: Meeting the Challenges of an Uncertain World*; and Melia, *"Damn the Torpedoes": A Short History of U.S. Naval Mine Countermeasures, 1777-1991*.

PRESSURE PLATE: In land warfare, a mine actuated by direct pressure from the target . Pressure plate mines are used to discriminate targets. A typical antitank pressure plate mine requires 300 pounds of pressure to activate.

PRESSURE: In land warfare, a mine whose fuze responds to the direct pressure of a target. In naval warfare, a mine whose circuit responds to the hydrodynamic pressure field of a target.

RISING OR RISING VERTICAL MINE (RVM): A naval mine having positive buoyancy which is released from a sinker by a ship influence or by a timing device. The mine may fire by contact or influence. Propelled rising mines have negative buoyancy, but are rocket/torpedo propelled from the bottom or moored casing to attack the target.

SMART MINE: A mine with a microprocessor that allows the influence mechanism to discriminate between real and false targets. Can be preset to react to a specific ship type or class.

SEISMIC: A mine responding to vibrations caused on the ground/bottom by the target.

TILT ROD: A mine used in land warfare and as a naval antilanding mine actuated by direct pressure against a rod causing it to tilt to a set limit.

TRIP WIRE: An antipersonnel mine actuated by pressure or movement of a wire.

APPENDIX C: MCM FORCES AND CAPABILITIES¹

UNITS	FORCE STRUCTURE	NOTES
Operational Command and Control	Mine Countermeasures Squadron ONE and TWO	Deployable MCM squadron staffs home ported in Ingleside, TX.
MCM Command and Control/Support Ship	USS INCHON MCS-1 (formerly LPH-12). Carries support (parts, supplies, Tech's) and serves as an in theater Command and Control platform.	In service July 1996. Home ported in Ingleside, TX. Can embark and operate AMCM units.
SURFACE MCM Ships	MCM-1 AVENGER class. 1,312 tons at full load, 224 ft LOA, 39 ft beam. Capable of hunting, neutralizing and conventional sweeping.	14 ships, 4 in reserves. 2 vessels forward deployed to the Persian Gulf, and 2 forward deployed to Japan. Remainder home ported in Ingleside, TX.
SURFACE MCM Ships	MHC-51 OSPREY class. 851 tons at full load, 188 ft LOA, 36 ft beam. Capable of hunting and neutralizing, no current sweep capability.	12 ships, 11 in reserves. Designed for harbor and coastal clearance ops, all have been upgraded for 15 days endurance. All home ported in Ingleside, TX.
AVIATION MCM Aircraft	MH-53E SEA DRAGON AMCM HELICOPTER. Capable of hunting and sweeping.	24 aircraft, 12 in reserves: planned home port at NAS Corpus Christi, TX.
EXPLOSIVE ORDNANCE DISPOSAL UNITS	EOD MCM detachments. Diver and support personnel for surveillance, reconnaissance, neutralization, and exploitation.	12 units
NAVY SPECIAL WARFARE	SEAL and support personnel for surveillance, reconnaissance, neutralization, and exploitation.	Platoon sized units

¹ Sources consulted include: *Mine Warfare Campaign Plan*; *Assault Breaching Tool Box Development*; *Mine Warfare Plan: Meeting the Challenges of an Uncertain World*; *Amphibious Operations in a Mine Environment*; and *NAVSEA Mine Familiarizer*.

USMC RECON UNITS	USMC RECON swimmers capable of surveillance, reconnaissance, neutralization, and exploitation.	Number and size based on mission of MAGTF embarked: MEF, MEF(FWD), MEU, MEU(SOC).
SPECIAL UNITS	EOD MARINE MAMMAL detachments. Capable of marking contacts	MK 7 Marine mammal det, 3 units
CAPABILITIES	EMPLOYMENT	NOTES
AN/AQS 14 SONAR SYSTEM	Airborne sonar system used in the RH-53D Sea Stallion and MH-53E Sea Dragon helicopters.	Side scan sonar system, active-controlled, helicopter-towed mine hunting system.
AN/AQS 20 SONAR SYSTEM	Developmental system for installation in MH-53E Sea Dragon helicopters.	Intended replacement for the AN/AQS 14 SONAR
AN/SQQ 30 SONAR	Variable depth sonar system installed on hulls 2-9 of the MCM-1 AVENGER class	Mine detection and classification sonar, variable depth .
AN/SQQ-32	Improved variable depth sonar system installed on MCM-10 through 14 and all MHC-51 OSPREY class ships.	Improved mine detection and classification sonar, variable. Improvements are in ranges of detect/classify arrays, and enhanced contact resolution quality.
SPU 1W (MOP)	Magnetic sweep system used by MH-53E AMCM units and MCM-1 AVENGER class SMCM units.	(MOP) magnetic orange pipe, towed body used to sweep magnetic mines, shallow water capability.
A MK 2(G)	Acoustic sweep system used by MH-53E AMCM and MCM-1 AVENGER class SMCM units.	Medium to high frequency acoustic sweep system.
MK 103	Moored mine sweeping system used by MH-53E AMCM units.	Sweep wires with explosive cutters to cut mooring cables of moored mines.
MK 104	Acoustic sweep system used by MH-53E AMCM units.	Towed body used to sweep acoustic mines up to 30 feet of water depth.

CAPABILITIES	EMPLOYMENT	NOTES
MK 105	Generator powered magnetic sweep system used by MH-53E AMCM units.	Towed sled with integral generator for magnetic sweeping, can be towed up to 25 knots and will operate in water depths of 12 feet and greater.
MK 106	Acoustic/magnetic sweep system used by MH-53E AMCM units.	Combination of the MK 105 sled and the MK 104 towed body.
AN/SLQ 38	Moored mine sweeping system used by MCM-1 AVENGER SMCM units.	Mechanical/Oropesa wire sweep with explosive cutters to cut mooring cables of moored mines in shallow water.
AN/SLQ 53 Single Ship Deep Sweep System	Developmental system for modular installation on the MHC-51 OSPREY class ships.	Wire sweep system with deep and shallow water capability against moored mines.
A MK 4(V)	Acoustic sweep system installed in MCM-1 AVENGER class ships.	Towed acoustic sweep system for medium frequency acoustic fired mines.
A MK 6(B)	Acoustic sweep system installed in MCM-1 AVENGER class ships.	Towed acoustic sweep system for low frequency acoustic fired mines.
M MK 5	Magnetic sweep system installed in MCM-1 AVENGER class ships.	Towed cable that acts as an electrode and creates a magnetic field to sweep magnetic mines. Cable is powered by a mine sweep generator installed in ship.
M MK 6	Magnetic sweep system installed in MCM-1 AVENGER class ships.	Principle is same as M MK 5 but cable configuration differs and can be configured in a closed-loop or “J-sweep” method.
AN/SLQ 37	Magnetic/Acoustic influence sweep installed in MCM-1 AVENGER class ships.	Combination of M MK 5 magnetic sweep system and either A MK 4(V) or A MK 6(B) acoustic sweep or both.

CAPABILITIES	EMPLOYMENT	NOTES
AN/SLQ 48(V) MNS	Remotely piloted Mine Neutralization Vehicle installed in MCM-1 AVENGER and MHC-51 OSPREY class ships.	Submersible mine hunting vehicle operated from a ship and powered/controlled by an umbilical cable. Vehicle has low light television and high resolution sonar and transponder that allow ship to track its movements. Capable against moored and bottom mines.
MK 16 UNDERWATER BREATHING APPARATUS (UBA)	Underwater rebreather system used by EOD, SEAL, and RECON divers.	Rebreather system designed to be acoustically and magnetically silent to prevent mine detonation during diving operations.
AN/PQS 2	Diver hand held sonar system for use by EOD, SEAL, and RECON divers.	Hand held sonar system with range up to 120 yards; some capability against partially buried mines.
MK 10 AND MK 25 ORDNANCE LOCATORS	Hand held ordnance locators for use by EOD, SEAL, and RECON divers.	A metal detector type system used to locate buried mines. Has a 20 yd radius.
MK 1 MINE CLEARANCE SYSTEM	Primary explosive breaching system for USMC, employed from Amphibious Assault Vehicles (AAVs).	System uses three MK-59 mine clearing line charges to conduct breaches from the water. Can form a breach lane up to 270 meters in length. Primarily land mine countermeasure, but can be used in the surf zone (SZ).
MK 2 MINE CLEARANCE SYSTEM	Trailer mounted mine clearing line charge (M-58) operated from a variety of vehicles.	Line charge system used in the surf zone (SZ), beach, and craft landing zones (CLZs).
MULTIPURPOSE CRAFT, AIR CUSHION (MCAC)	LCAC configured for MCM use.	LCAC configured to fire M-58 line charges to clear breach lanes. Used in the surf zone (SZ), beach, and craft landing zones (CLZs).
SHALLOW WATER ASSAULT BREACHING (SABRE) SYSTEM	Enhanced linear demolition charge employed from LCACs and MCACs.	405 foot line charge for use in the surf zone (SZ).

CAPABILITIES	EMPLOYMENT	NOTES
DISTRIBUTED EXPLOSIVE TECHNOLOGY (DET) SYSTEM	Explosive net demolition charge employed from LCACs and MCACs.	180 foot by 180 foot net made of detonation cord used for wide area clearance in the surf zone (SZ).
TRACK WIDTH MINE PLOW (TWMP)	M1A1 tank mounted earth plowing system.	Furrows away buried and surface mines in the beach area up to 4 inches deep, 58 inches wide in front of each track. Does not neutralize mines, but moves them out of breach lane.
ANTIMAGNETIC MINE ACTUATING DEVICE (AMMAD)	Counter system for magnetic mines.	Used in conjunction with track width mine plow or mine rollers.
MINE ROLLERS	10 ton metal rollers fitted to front of the M1A1 tank.	Counters mines in the beach areas by rolling over and detonating them. Service life is two mine detonations. Not a primary clearance system.
ARMORED COMBAT EARTHMOVER	Armored and hardened dozer type vehicle.	Can be used to plow through mine fields, but not specifically designed for this use.
BULLDOZERS	Standard construction equipment operated by Combat Engineers or Naval Construction Battalion personnel.	Can be used to plow through mine fields, but not specifically designed for this use.

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Rochlin, Gene I., and Chris C. Demchak. *Lessons of the Gulf War: Ascendant Technology and Declining Capabilities*. Berkeley: University of California, 1991. This short book provides a clear and concise explanation of how U.S. force structures have evolved with a great reliance on technology. There are a number of examples of qualitative assessments of performance of the high-tech weapons employed during the Gulf War. Additionally, this book provides some interesting discussions on the costs of weapon employment. Not specifically related to mine warfare, but very useful in understanding how the entire U.S. military force structure came into being.

Science Applications International Corporation. *Focus on the Littorals*. Unpublished research paper funded by Naval Doctrine Command. Contract No. N00039-94-D-0072. 28 June 1996. This paper discusses naval expeditionary operations in the year 2010. Subjects addressed include all aspects of naval operations in the littoral from the standpoint of supporting *Operational Maneuver from the Sea*, and *Sea Dragon* concepts. Comprehensive overview of the interrelationships of the various aspects of expeditionary naval warfare.

Strange, Joe. *Centers Of Gravity & Critical Vulnerabilities: Building on the Clausewitzian Foundation So That We Can All Speak the Same Language*. Number Four of *Perspectives on Warfighting*. Quantico, VA: Marine Corps Association, 1996. This book offers a detailed explanation of the linkage of critical capabilities, critical vulnerabilities, and centers of gravity. Dr. Strange also discusses the disparities between the concepts of center of gravity among the services.

Task Force Eagle. *Task Force Eagle Mine Awareness Tactics, Techniques and Procedures Handbook*. Tuzla Airbase, Bosnia-Herzegovina : Headquarters, Task Force Eagle, 21 March 1996. This tactical handbook is useful to gain some insight into problems and concerns of ground forces in dealing with mines.

Provides a means for identifying issues of commonality in mine warfare for someone not familiar with land mines.

Tritten, James J. *Naval Perspectives for Military Doctrine Development*. Research Paper. Joint Electronic Library CD-ROM, September 1996. This research paper discusses in great detail the relationships between policy documents, doctrine, and tactics, techniques and procedures. Excellent source for a scholarly discussion on the relationships of these documents, and their developmental process. Does not specifically address mine countermeasures, but does offer some insight into the larger context of supporting activities and operating forces.